Electroluminescence from polycrystalline CdTe films - R. T. Collins et al., Colorado School of Mines, DMR0103945 - Electroluminescence (EL) from polycrystalline CdTe films fabricated into a CdS/CdTe heterojunction diode has been observed. Figure 1 shows a typical spatial image of this EL emission acquired using a CCD detector. The device shows bright emission spots superimposed on a less intense background. Although these CdTe films were deposited by a vapor transport technique, we have observed this type of inhomogeneity in films deposited by many techniques. Figure 2 shows low temperature spectrally resolved measurements of the EL and of photoluminescence (PL) obtained by conventional laser excitation. The positions of the lines, and similarity of EL and PL spectra clearly identifies the emission as originating within the CdTe layer.

The ability to directly observe EL is potentially very useful since, unlike PL, EL originates in the specific layer of crystallites making up the depletion region and involved in current transport and recombination. Hence, EL samples a more localized and interesting part of the film. Particularly intriguing are the brighter emissions spots in Fig. 1. Transport through polycrystalline films is not necessarily uniform relying on how well "connected" the various grains are through their grain boundary walls. We speculate that these brighter spots arise from higher current carrying regions although regions of higher sulfur concentration, or reduced defect state density, are also possible explanations.

Future work, using the high spatial resolution of near-field scanning optical microscopy in conjunction with a high sensitivity spectroscopy system (to be purchased in the second year of this grant) will be directed at clarifying the origin of inhomogeneous emission. Samples with an optimal structure for the study have been secured through a collaboration with Al Compaan's group at the University of Toledo. Topographic (AFM) and optical (EL and NSOM photocurrent) characterization showing the same type of inhomogeneity has been performed. If our speculation about the source of this inhomogeneity is confirmed, monitoring EL while varying growth parameters, subjecting films to lifetime stress tests, or applying various passivation treatments to grain walls will allow a unique non-destructive method of monitoring the effects of these treatments on a broad range of polycrystalline semiconductor films.

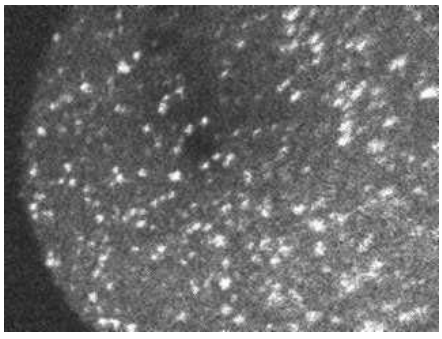

Fig. 1 EL image of CdTe/CdS pn junction at room temperature obtained by 480 second CCD integration. The excitation current density was 40 mA/cm^2 and the gold contact pad radius is 0.96 mm.

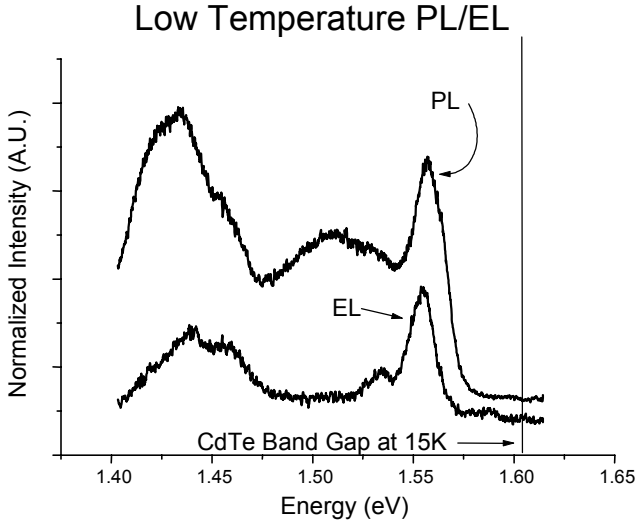

Fig. 2 EL and PL from CdTe/CdS cell at ~15K. PL excitation He-Ne; EL excitation J = 86 mA/cm^2 at 4.6 V.